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Xth Sense: researching muscle sounds for an experimental paradigm of musical performance

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Augment human body and its environment to explore relations models between men and machines (digital interaction?)

Gestural Control of Music

From mice and sliders
to virtual / augmented instruments
and...

Biophysical Control of Music

...biosensing technologies

(Rosenboom, Knapp, Tanaka, Nagashima, Miranda)

Alvin Lucier 1965, Music For Solo Performer

Long-term research outcome

Implementation of low cost, open source tools (software and hardware) for biophysical-aided sound design in a real time environment:

Re-distributable
Customizable
Easy to set up

The realization process needed to be fragmented into more specific and measurable steps.

Aesthetic principles

for an experimental coupling between theatrical gesture and muscle sounds.

- Authenticity of the performer's somatic interaction;
- Natural responsiveness of the system;
- Expressive immediacy and transparency of the mapping of muscle sounds to the performer's kinetic behaviour.

Methods

- Aesthetic study of the acoustics of muscle sounds

(implementation of an audio synthesis model for muscle sounds)

- Development & design of the Xth Sense

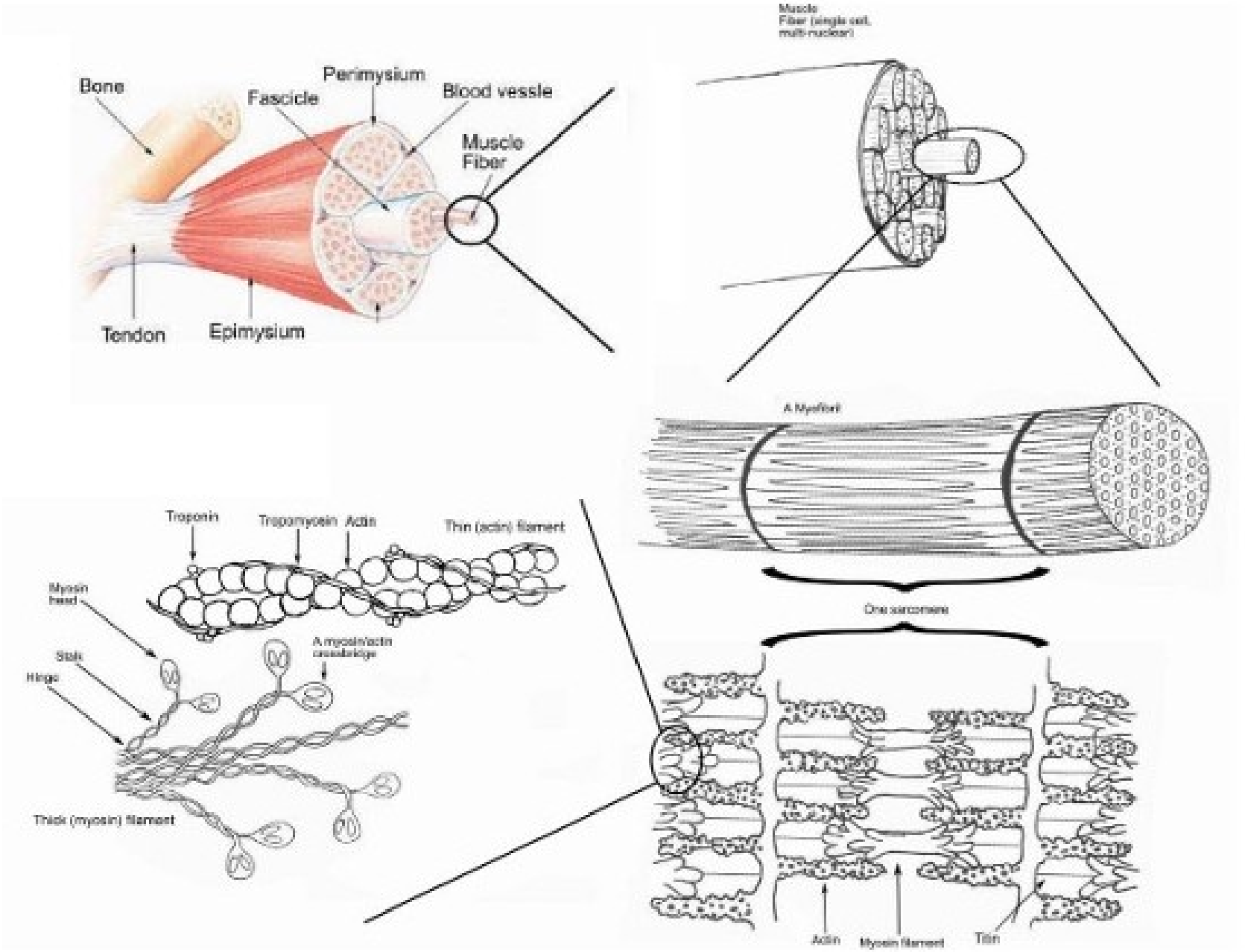
(a wearable biophysical sensor device)

- Implementation of a Pd-based -rt DSP framework

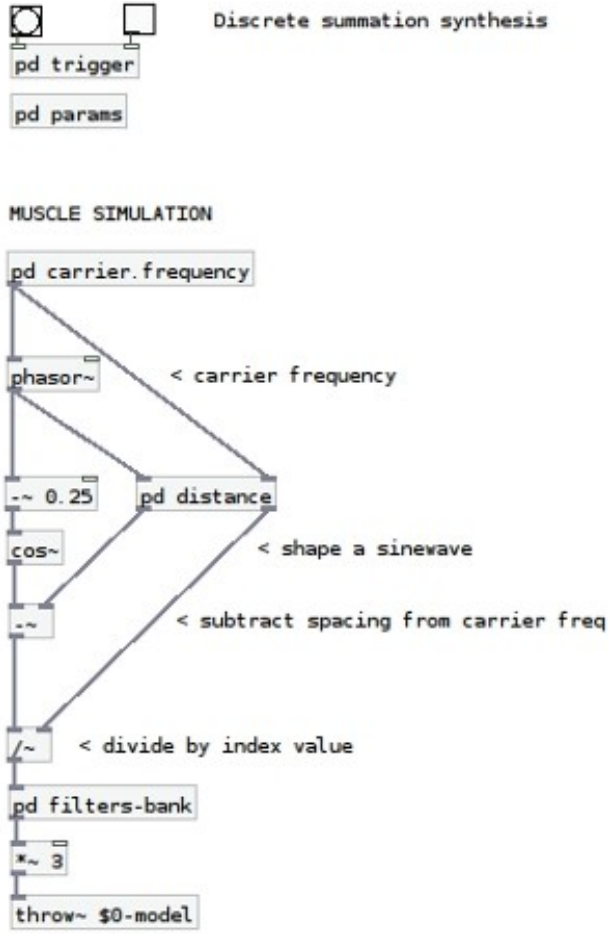
(to capture, analyse and design with muscle sounds)

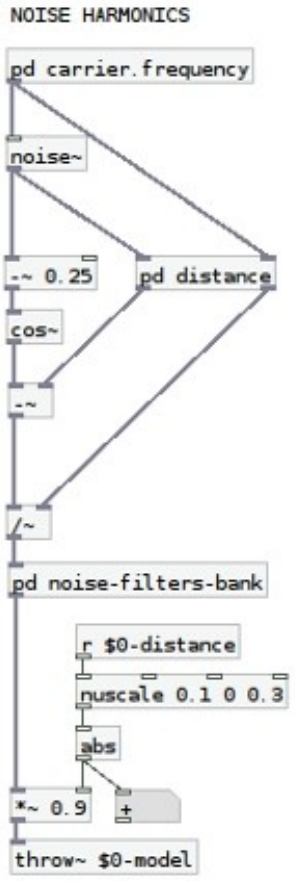
- Performance testing

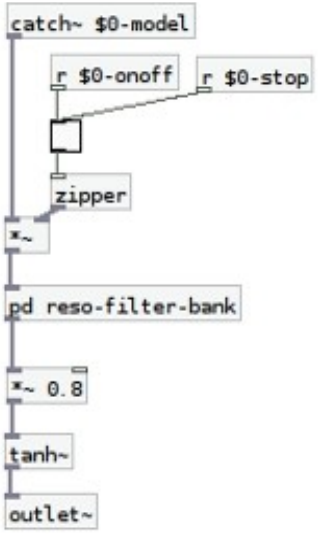
(to establish mapping and design definitions)


Bone
Fascicle
Perimysium
Blood vessle
Muscle Fiber
Tendon
Epimysium
Muscle Fiber (single cell, multi-nucleate)
A Myofibril
One sarcomere
Troponin
Tropomyosin
Actin
Thin (actin) filament
Myosin head
Stalk
Hinge
A myosin/actin crossbridge
Thick (myosin) filament
Actin
Myosin filament
Titin

A synthesis model for muscle sounds







Human muscle sound synthesis model.

Coded by Marco Donnarumma, based on discrete summation synthesis algorhythm included in 'Designing Sound' by Andy Farnell.

Edinburgh, 2010

The *Xth Sense / S*ensor implementation

a **wearable**, unobtrusive and
extremely **sensitive** device

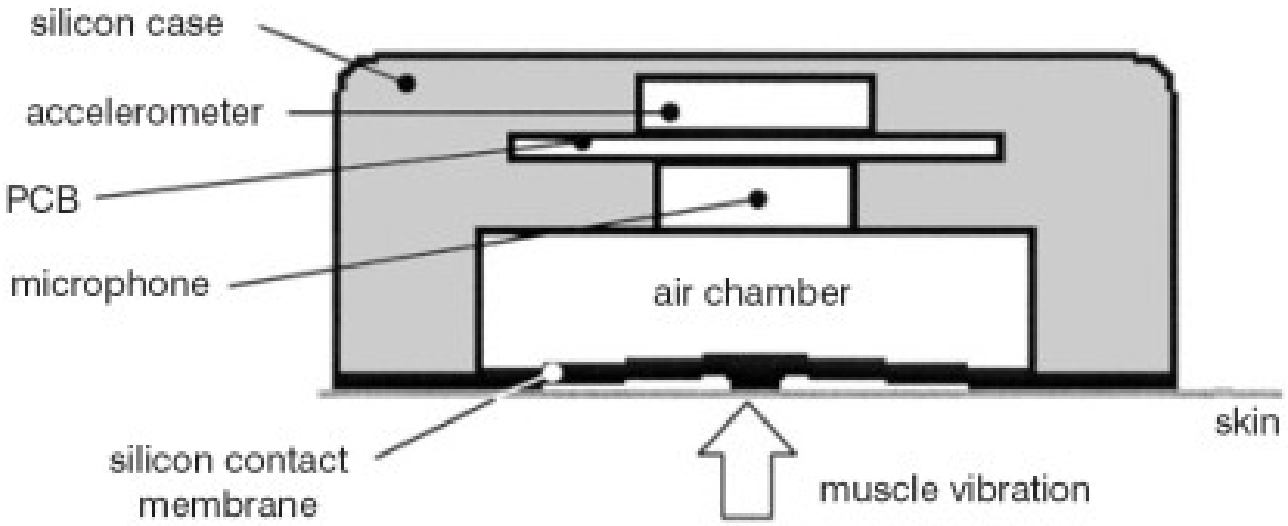
(efficient rt capture <==> very low latency);

using

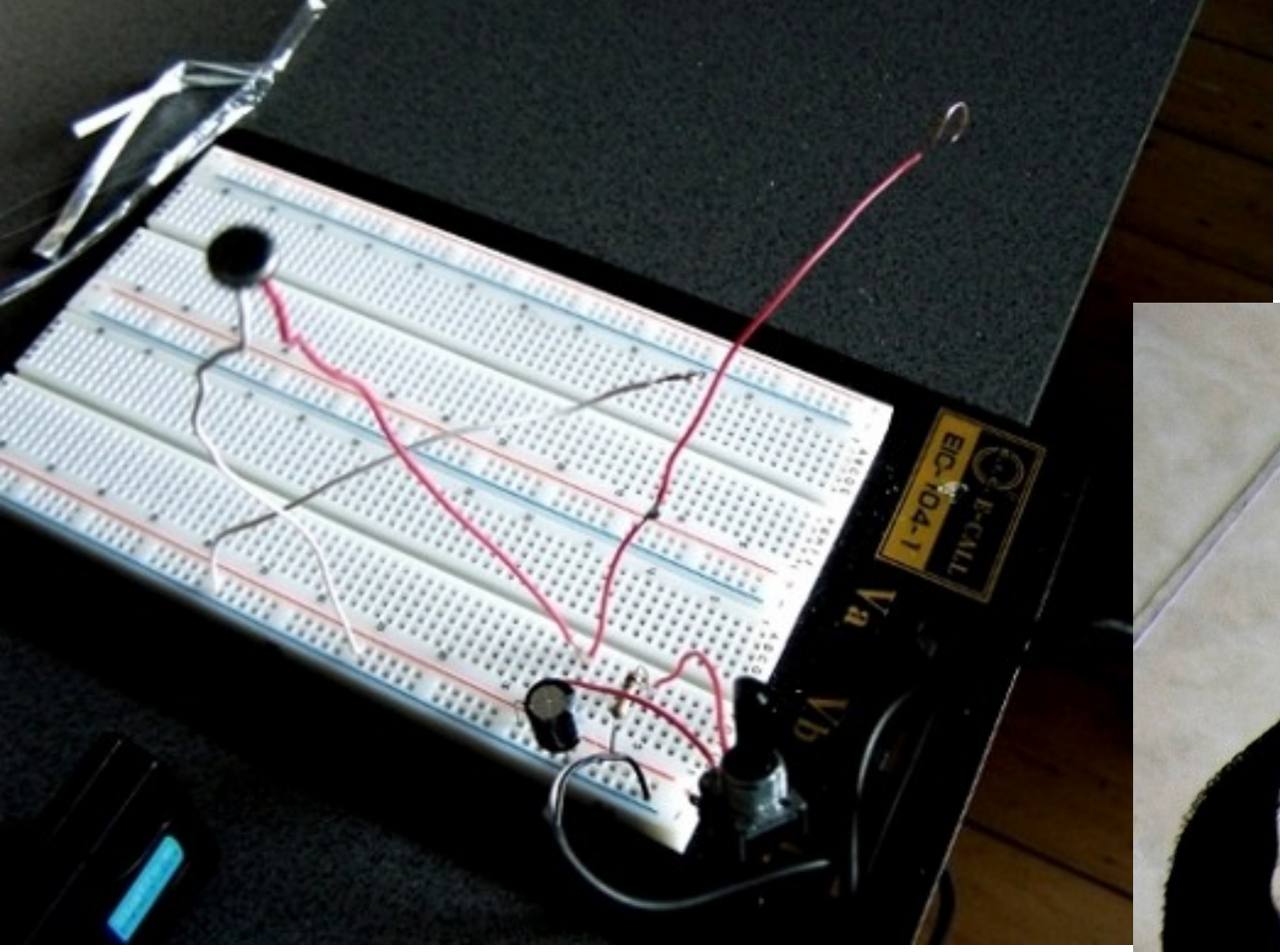
the most **inexpensive** hardware
and **accessible** production methodology

(to foster re-distribution and openness of the hardware).

(Open Source) Biomedical computing?



CMASP schematic by Jorge Silva, Prism Lab, 2004

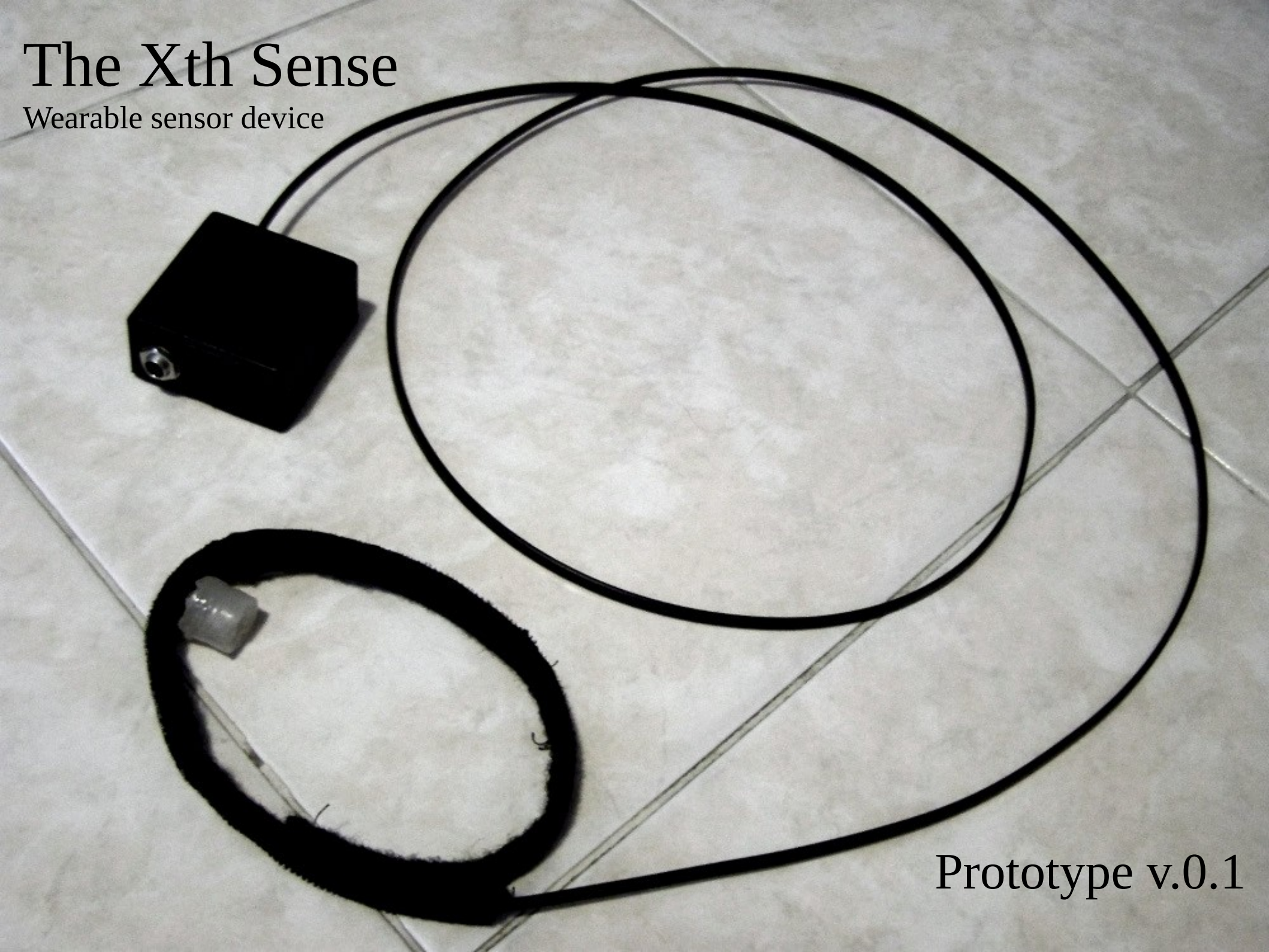


Prototyping...

...and
hacking

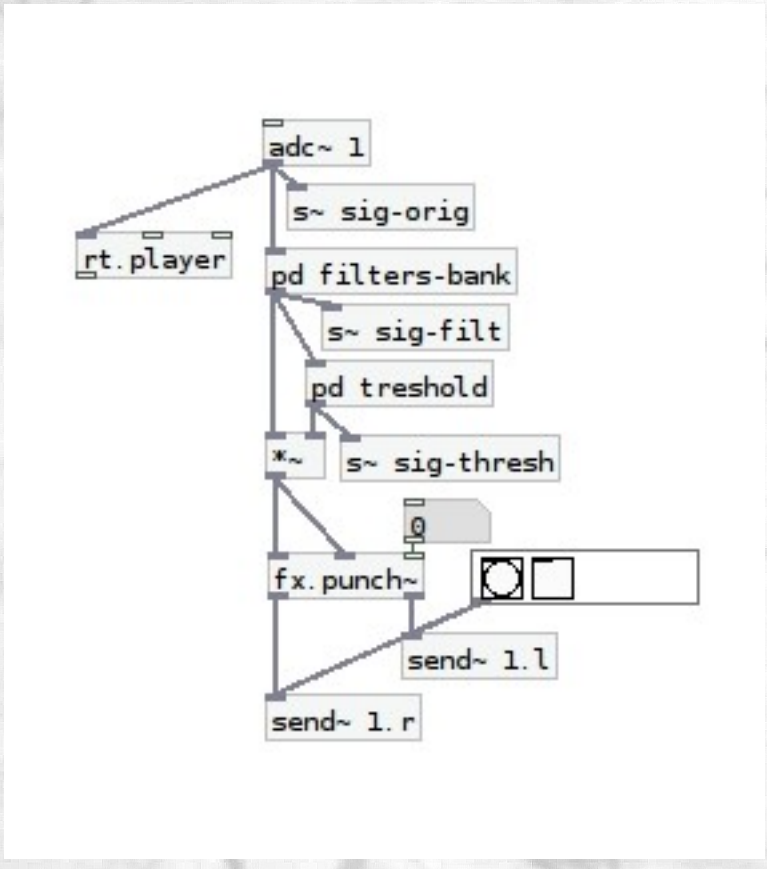
The Xth Sense

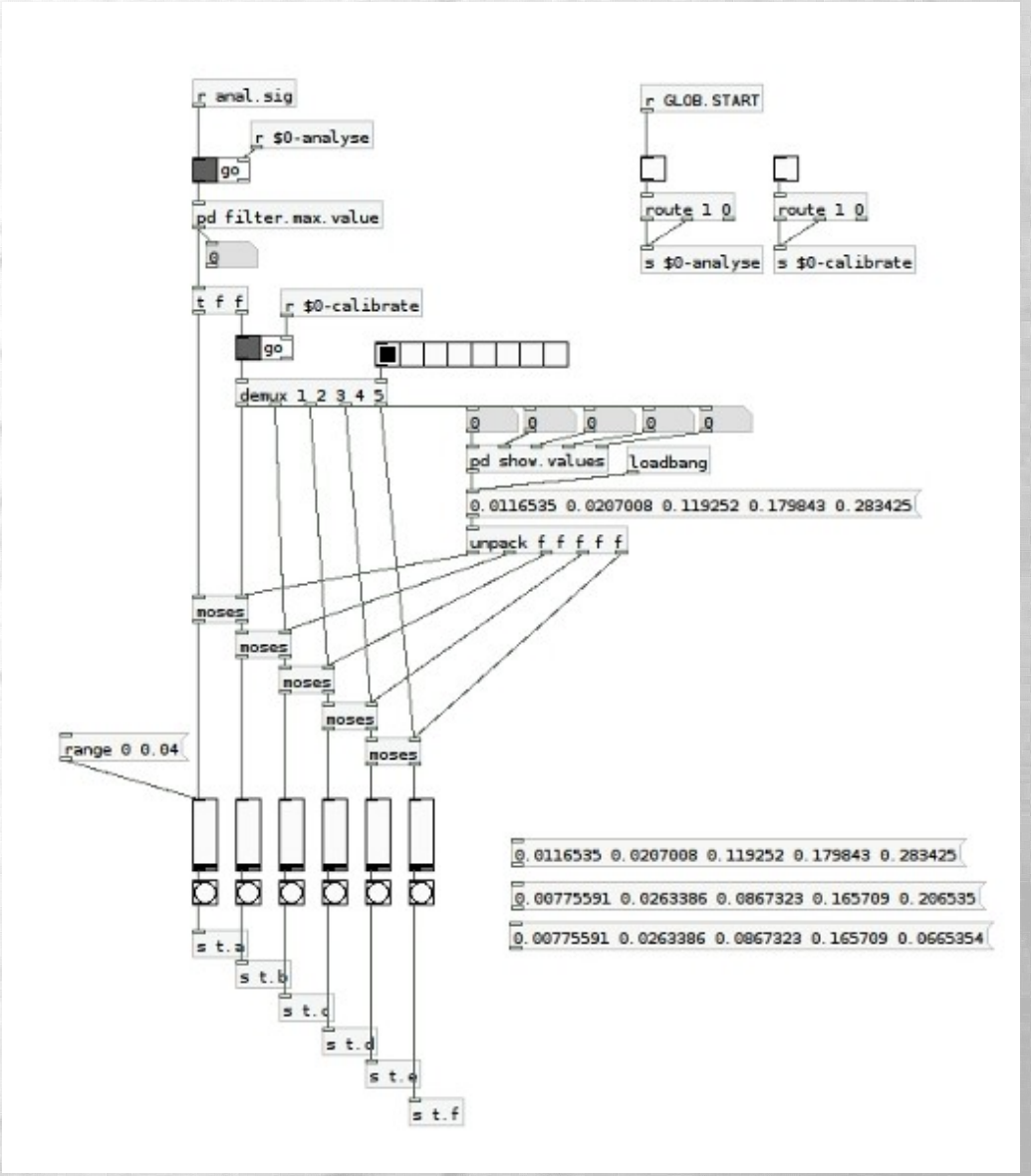
Wearable sensor device



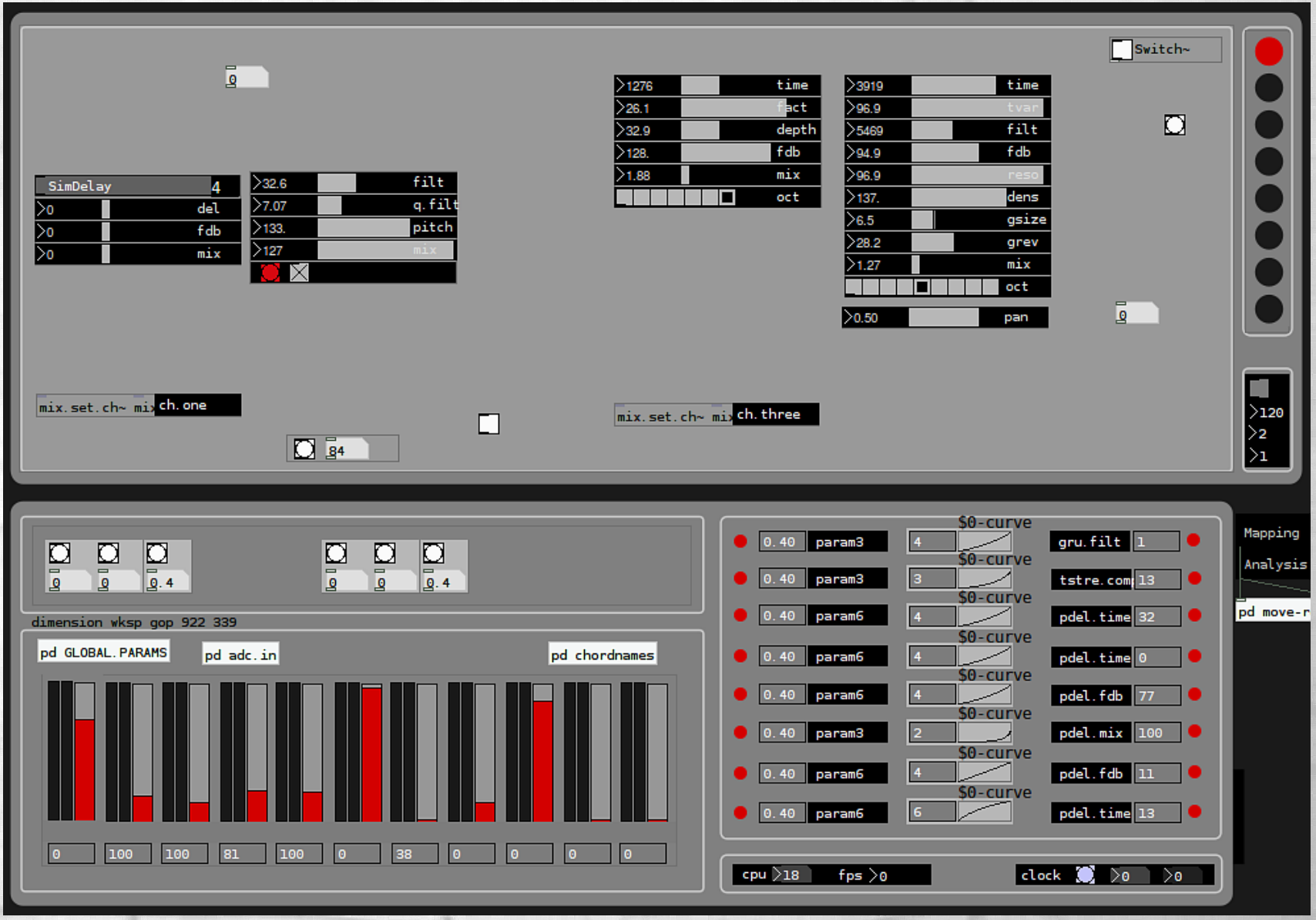
Prototype v.0.1

The *Xth Sense* / *R*eal time DSP modular framework





The *Xth Sense* / *R*eal time DSP modular framework



Extracting useful data

Mechanical Myography (MMG)

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RMS amplitude features extraction

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8 variables:

6 discrete events, 1 continuous moving event and 1 continuous exponential event.

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Mapping kinetic energy to control data

Performance testing: mapping and design definitions

- biological sounds as major sonic source and control data;

- no direct interaction of the performer with a computer
(conceal the latter from the view of the public);

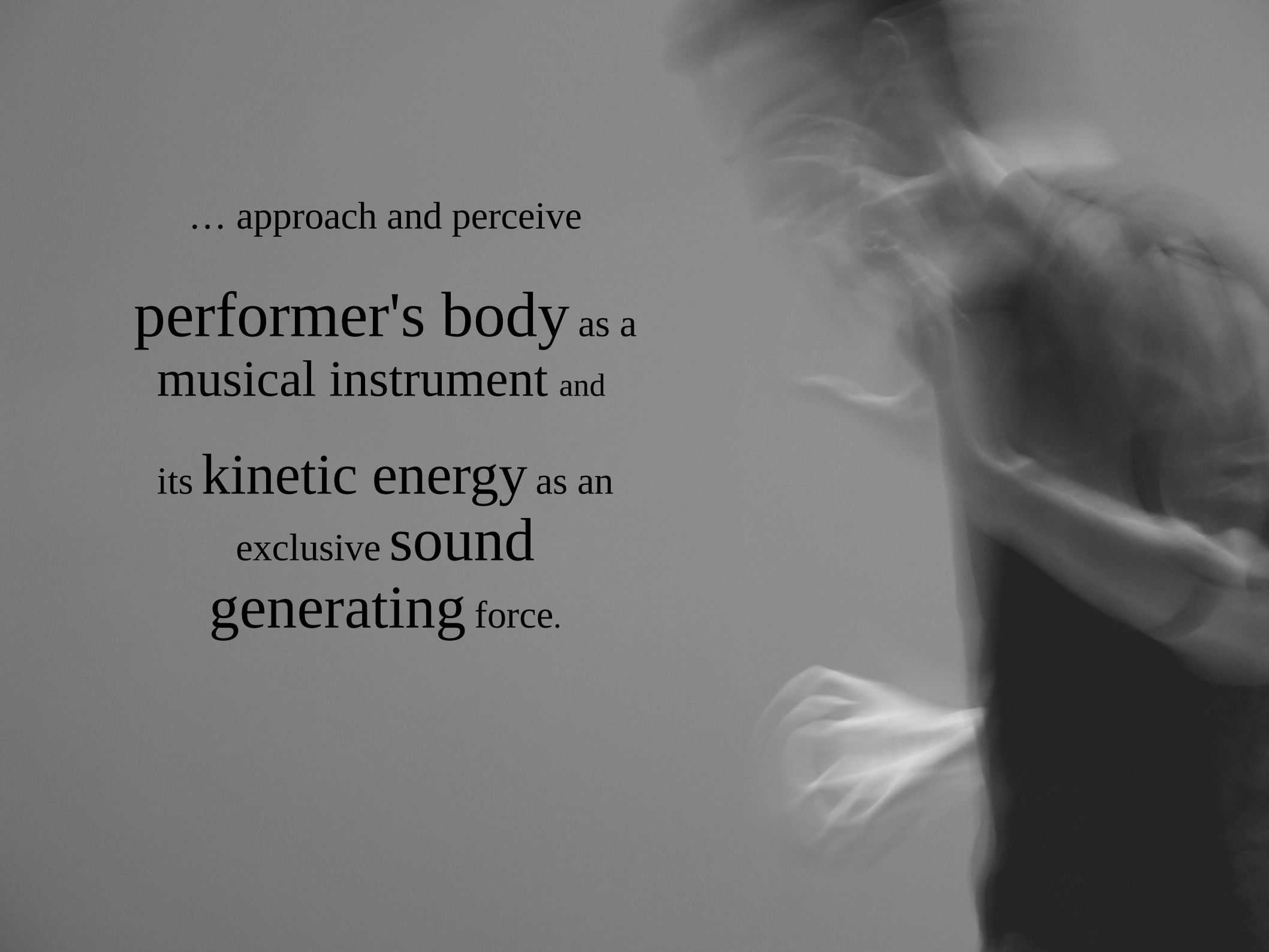
- distinct, natural and non-linear interaction between kinetic energy and sonic outcome
(instinctively controlled by the performer);

- rich, specific and unconventional vocabulary of gesture/sound definitions
(unambiguously interpreted by the audience);

- ...

… approach and perceive

performer's body as a musical instrument and its kinetic energy as an exclusive sound generating force.



Music for Flesh II

Solo piece for augmented muscle sounds (Xth Sense Tech)

Issues of interest and improvements

- Excellence in the quality of the sonic matter
(more accurate and ad hoc processing);

- Deeper understanding of muscle sounds spectrum and dynamics
(better control of multi-layered muscles);

- Multiple sensors / Pattern gesture recognition
(ANN, Neural Networks?);

- Wireless system
(dance, theater).

Further research contexts

Development residency/ies
(Inspace, UoE, School of Informatics, Edinburgh, ...)

Workshop/s
(NK Berlin, Culture Lab Newcastle, Transfera Madrid, …)

Presentations / Concerts
(Pd mini Con, ImagineCreate, LAC, ICMC, ...)

Seminary
(HGG - Danish National Dance School)

Pictures Courtesy of the author, NASA, Mark Daniels (Artistic Director @Inspace), Chris Scott (chrisdonia.co.uk).

Thanks to the Pure Data Community, Linux Audio.org, Dr. Martin Parker @UoE.

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